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SHOCK-WAVE SYNTHESIS OF ALUMINUM OXIDE WITH THE SPINEL STRUCTURE FROM ZINCITE AND ALUMINUM

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The results of x-ray study of shock-wave impact on zincite and aluminum are described. It is established that such impact produces aluminum oxide with spinel structure (a = 7.953 Å), zinc, and zinc oxide with cubic structure of the NaCl type (a = 4.265 Å).

The present paper considers the results of x-ray study of products that were formed under shock-wave impact on zincite placed inside a conservation container (Fig. 1) whose design was described earlier [1]. A zincite sample (GOST 10262–73) weighing 0.36 g was placed inside the narrow channel *1* (4 mm in diameter) of a thick-walled aluminum tube *2* (8 mm in diameter) arranged coaxially with respect to the axis of the cylindrical steel conservation ampoule *3* (external diameter 13 mm). In order to avoid split-off destruction of the conservation ampoule, its bottom end was placed in contact with a thick steel plate.

The shock-wave loading was implemented via a gliding detonation wave produced by explosion of a charge, which represents an alloy of trotyl and stabilized hexogen with the density 1.67 g/cm^3, placed inside a steel shell.

The detonation was initiated by an azide drop explosion via a plane-wave generator. The detonation speed was 8100 m/sec, and the detonation wave pressure was 26 GPa.

After the ampoule was opened, traces of intense hydrodynamic mixing of the material of the thick-walled aluminum tube and the material placed inside the tube channel could be observed along the axis of the ampoule, which corroborates the earlier assumption regarding the character of the conservation ampoule deformation [1].

The x-ray phase analysis was carried out in a focusing monochromator chamber FR-552 with Cu$K_{\alpha 1}$ radiation (germanium as the reference standard).

The analysis of the x-ray patterns of the products resulting from shock-wave impact on the conservation ampoule indicated that zinc oxide had been virtually completely reduced to metal, whereas the aluminum shell had been partly oxidized to aluminum oxide with spinel structure (Table 1), unit cell parameter a = 7.953(3) Å. The interplanar distances of the resulting aluminum oxide in fact did not differ from σ-Al_2O_3 [2]. Some lines with hkl = 422, 511, and 440 did not coincide in intensity with the σ-Al_2O_3 lines.

Besides the lines presented in Table 1, two other lines (with low intensity) were observed in the x-ray pattern, whose interplanar distances were 2.132 and 1.508 Å. These lines and the wide line 2.462 Å are indexed in the cubic face-centered lattice with a = 4.265 Å. Thus, the results of the x-

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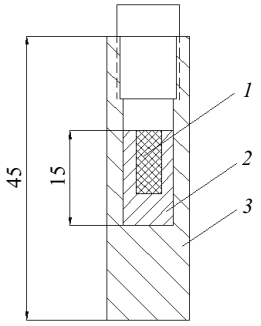

Fig. 1. Conservation ampoule with aluminum insert.

TABLE 1

Intensity	Interplanar distance, Å			*hkl*
	alumina	zinc	σ-Al_2O_3	
5	2.814	–	2.810	220
20sh	–	2.462	–	–
30	2.395	–	2.396	311
25	–	2.308	–	–
1	2.294	–	2.294	222
100	–	2.092	–	–
15	1.989		1.987	400
10	–	1.684	–	–
3	1.625	–	1.622	422
3	1.529	–	1.529	511
10	1.406	–	1.405	440
10sh	–	1.335	–	–

ray study suggest that zincite under a shock-wave effect transforms into a high-density modification with cubic structure of the NaCl type [3].

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